DOCUMENT RESUME

ED 081 735 SP 006 850

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TITLE	A Note on the Effectiveness of Teacher Experience.
INSTITUTION	Rand Corp., Santa Monica, Calif.
REPORT NO	P-5010
PUB DATE	Apr 73
NOTE	8p.
EDRS PRICE	MF-$0.65 HC-$3.29
DESCRIPTORS	*Academic Achievement; *Employment Patterns; High Achievers; *Reading Ability; Sex Differences; Social Class; *Teacher Employment; *Teacher Experience

ABSTRACT

To establish the relationship between reading ability and teacher turnover, a simultaneous evaluation model based on recent data from the San Diego School District was developed. A two-stage least squares estimation procedure was employed, modified by the introduction of three exogenous variables: percent of students from poor backgrounds, sex of the teacher, and teaching experience. Reading ability was strongly and negatively related to student social class, and teacher turnover was negatively related to reading ability of schools. Analysis suggested that the relationship between experience and achievement was the ability of experienced teachers to become employed by schools with a student body of high achievers. (Author/JB)

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A NOTE ON THE EFFECTIVENESS OF TEACHER EXPERIENCE

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April 1973

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A NOTE ON THE EFFECTIVENESS OF TEACHER EXPERIENCE*

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INTRODUCTION

Recent studies have found a significant relationship between student achievement and teacher experience.** That is, schools with high achieving students tend to have a more experienced teaching staff. One view of this relationship is that more experienced teachers raise student achievement by better teaching. That is, in fact, a major rationale for salary increases based on teacher experience. However, causality may run the other way. It has been suggested that rather than teacher experience affecting student test scores, the average reading ability of a school determines the faculty's average level of experience: teachers move to schools attended by superior test takers--and once there they seldom return to a poorer school.*** From this point of view, teacher experience levels are actually the result of teacher turnover, i.e., of teacher departures from the less attractive schools. This note makes a study of such departures in an attempt to discriminate between these two possible reasons for the experience-reading scores relationship.

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*We are indebted to Phoebus J. Dhrymes for his valuable suggestions and comments.

**See H. Averch, S. J. Carroll, and T. S. Donaldson, What Do We Know About Education Effectiveness? The Rand Corporation, unpublished manuscript. J. Burkhead, T. G. Fox, and J. W. Holland, Input and Output in Large City High Schools, Syracuse University Press, Syracuse, New York, 1967; D. Greenberg and J. McCall, Analysis of the Educational Personnel System: I. Teacher Mobility in San Diego, The Rand Corporation, R-1071-HEW, January 1973; and J. W. Guthrie, "A Survey of School Effectiveness Studies," Chapter 2 in Do Teachers Make a Difference? HEW, OE-58042, 1970.

***D. Greenberg and J. McCall, op. cit.

It could be argued that teacher departures cause students to have reduced reading ability. Any school that exports a large number of teachers will generally get young and inexperienced teachers as replacements. Such teachers may not do a good job of teaching until they accumulate some experience. Teacher turnover during the school year should be exceptionally detrimental to students.

On the other hand, reading ability and factors related to it such as the race and class of students may cause or influence teacher departures. In general, white middle-class schools, where students possess high reading ability, are more attractive to most teachers.* The connection between turnover and reading ability will be stronger if there are such school characteristics as a poor plant, or location near an airport, that impair both teacher satisfaction and student learning.

Thus, reading ability and teacher turnover should be jointly determined. In this note, we develop a simultaneous equation model of the relationship and test it on recent data from the San Diego School District. This data comes from a File constructed at Rand from information supplied by the San Diego City Schools Personnel Division.**

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*In most school districts salaries are constant across schools for teachers with identical characteristics. In these circumstances the mobility of teachers among schools is best explained by a proxy wage system based on school quality differentials. See Greenberg and McCall, op. cit.

**A detailed discussion is presented in Chapter IV of Greenberg and McCall, op. cit. This file contains information on each teacher's age, sex, race or ethnic background, number of semester hours completed, and number of years of teaching experience, both within and outside the San Diego school system. It also contains a complete description of the mobility of teachers among the San Diego schools (elementary, junior high and senior high) between the 1970-1971 and 1971-1972 school years. Schools are listed with such student body characteristics as percentage scoring above the national median on reading, median I.Q., percentage of families on welfare (A.F.D.C.) and with a subjective ranking of ease of administration obtained from a panel of school administrators.

METHODOLOGY

For the reasons given above, we would like to estimate teacher turnover rates and school reading scores simultaneously. Thus, ordinary least squares (OLS) will not be appropriate. For, fundamental to the validity of OLS is the assumption that the independent variables are uncorrelated with the stochastic disturbance, and this assumption is violated whenever the equation being estimated by OLS belongs to a system of simultaneous euqations, i.e., a system of stochastic relations which each observation is required to satisfy. To obtain consistent estimators of the parameters of a simultaneous equation system, we must replace OLS by a simultaneous equation estimation procedure like two-stage least squares (2SLS).*

Let Y_1 denote average reading ability at a school and Y_2 be the turnover variable ($Y_2 = 1$ if a teacher leaves, $Y_2 = 0$ if the teacher doesn't leave). We might try the following system of simultaneous equations:

$$Y_1 = \alpha_0 + \alpha_1 Y_2 + \epsilon_1$$
$$Y_2 = \beta_0 + \beta_1 Y_1 + \epsilon_2. \qquad (1)$$

Unfortunately, even 2SLS won't work in this case; the equations are essentially identical.** To remedy this, and to control for other influences on reading ability, and teacher turnover, we modify the equations by introducing the three exogenous variables: X_1 -- percent of AFDC students,

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*Roughly speaking, an estimator is consistent if its probability distribution becomes more concentrated about the true value of the parameter as the sample size increases. For a discussion of two-stage least squares estimation, see P. J. Dhrymes, Econometrics, Harper & Row, New York 1970.

**This is the "identification" problem. See Dhrymes, op. cit.

X_2 -- teacher sex (male = 1, female = 0), X_3 -- 1/(number of years teaching in San Diego), and then apply 2SLS to estimate the α's and β's in the following system:*

$$Y_1 = \alpha_0 + \alpha_1 Y_2 + \alpha_2 X_1 + \epsilon_1 \qquad (2)$$

$$Y_2 = \beta_0 + \beta_1 Y_1 + \beta_2 Y_2 + \beta_3 X_3 + \epsilon_2.^{**}$$

RESULTS

Table 1 reports the 2SLS estimates of the α's and β's and also the OLS estimates obtained when each equation in (2) is estimated separately by OLS. This was done for elementary schools, junior high schools and senior high schools. The OLS estimates of α_2 and β_1 are netative and highly significant at all three levels of schooling. In other words, reading ability is strongly and negatively related to the social class of students, and teacher turnover is negatively related to reading ability of schools. From the signs of β_2 and β_3, we see that inexperienced and male teachers are generally more likely to move.

A new structure emerges from the 2SLS analysis. The estimate of α_1 becomes large, negative, and significant. The estimate of β_1

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*The percent of AFDC is a measure of the students from poor backgrounds (i.e., of the student input into the school process). The measures of teacher characteristics are intended to measure the propensity of the teacher to transfer. The functional form for teacher experience, X_3 was chosen from data on transfers to preserve the linearity of the model.

**We also estimated a three equation system in which subjective ranking was included as a third endogenous variable. However, the 2SLS estimators fluctuated in an incomprehensible manner across the three levels of schooling -- elementary, junion high, and senior high.

increases and becomes more significant but the estimates of β_2 and β_3 stay about the same. This suggests that the reason more experienced teachers don't move as much is not just their inertia, but also that they are already at the schools they like. To put the size of α_1 and α_2 into focus, we note that the worst sixth of San Diego elementary schools (in terms of subjective ranking), have percent of AFDC 30 percent higher than the best, and turnover rates approximately 6 percent higher. Thus, the reading scores of those groups of schools will differ by (.06 x 33) = 2 points because of teacher turnover, and by (1.09 x 30) = 33 points because of student backgrounds. The reading parameter β_1 accounts for two thirds of

Table 1

OLS + 2SLS ESTIMATES OF TEACHER MOBILITY AND READING SCORES

	Estimate	Parameter						
		α_0	α_1	α_2	β_0	β_1	β_2	β_3
Elementary Schools	OLS	49.8	-.25	-1.13	.09	-.0007	.044	.062
			(.3)*	(65)		(2.3)	(2.9)	(2.8)
	2SLS	52.1	-33	-1.09	.11	-.0011	.043	.059
			(2.5)	(38)		(2.9)	(2.9)	(2.7)
Junior High Schools	OLS	65.8	-.35	-1.68	.10	-.0012	.012	.081
			(.5)	(90)		(3.5)	(.9)	(2.8)
	2SLS	67.1	-41	-1.57	.11	-.0014	.012	.077
			(2.4)	(28)		(3.7)	(.9)	(2.7)
Senior High Schools	OLS	69.7	.61	-2.33	.06	-.0008	.024	.079
			(.6)	(69)		(2.0)	(1.8)	(2.0)
	2SLS	70.3	-20	-2.28	.08	-.0011	.024	.074
			(1.2)	(38)		(2.6)	(1.8)	(1.9)

*The numbers in parenthesis are the t-statistics.

the difference in turnover. The analysis suggests that teacher turnover is a serious problem, but that the major reason for the relation between experience and achievement is the ability of experienced teachers to get to the schools of high achievers.

In conclusion we emphasize that the results obtained, while provocative, are tentative and, of course, only pertain to the San Diego School system. We plan to test the generality of these findings by performing similar analyses of comparable data for school districts in Michigan. We can also see if the same type of phenomenon holds across school districts. Finally, we will attempt to improve our empirical analyses by estimating the simultaneous system using three-stage least squares.